

The Man Who Loved Tortoises

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ABSTRACT

The captive breeding and management of the Western Swamp Tortoise *Pseudemydura umbrina* is a major zoological success story. Yet such programs do not operate in a social vacuum, and they have many critics. Science is a human activity and, as such, indivisible from social values. It is useful both for the scientific community and the wider community to ground our ideas of science by presenting the stories of scientists and the science they enact. This disrupts the diehard assumption that science is objective. For some, objectivity is held to be the indisputable gold standard for science; for others, objectivity is the, indelible original sin of science, which leads to an inevitable and dangerous disconnection from social and natural contexts. The reality of practising science is far more complex. This semi-biographical account of the history and people involved with the conservation of the Western Swamp Tortoise is intended to give a lively sense of science-in-action. Using a reflective essay style, it explores the story of the captive breeding of *Pseudemydura umbrina* within the social context of science, and includes a discussion of relevant ethical and political issues. It is therefore relevant to researchers interested in zoology, sociology of science, history of science, philosophy of science and ecocritical literature.

Key words: Captive breeding, Western Swamp Tortoise, *Pseudemydura umbrina*, zoology, sociology of science, history of science, philosophy of science, ecocritical literature.

Introduction

Threatened species (W.A. Wildlife Conservation Act); *Endangered* (ANZECC 1991); *Endangered* (IUCN Amphibia-Reptilia Red DataBook, Groombridge 1982); *Priority 1* (Action Plan for Tortoises and Freshwater Turtles, IUCN/SSC 1989); *Critically Endangered* (1995 Red List of Threatened Animals); *Endangered* (Endangered Species Protection Act 1992) (Burbidge and Kuchling 1994).

The lists above are a kind of conceptual transit lounge for animals on the verge of not being here. The Western Swamp Tortoise *Pseudemydura umbrina* features on all of them. In 1987, the total population of Western Swamp Tortoises was 20-30 in the wild, plus 17 captive individuals, including three adult females, barren since 1980. Perhaps 50 in total. In tortoise terms they are on the small side - the very largest males are no longer than 155 mm. Yet, in Western Australia at least, they loom large in the public psyche. A small tortoise plastered with luggage labels of endangerment: destination - extinction.

The standard colonial curses apply: most of the tortoises' habitat is destroyed by agriculture, industry and dwellings, and what's left is marginal; they are vulnerable to exotic predators, particularly the European Red Fox *Vulpes vulpes*; their tunnels are trampled by the hoofed animals of European pastoralism. But the 'burden of the white man' is not the only thing weighing on the tortoises. Their range began shrinking long before the arrival of Europeans, although they were locally common. The Swan Valley region, 30 kilometres north-east of Western Australia's capital, Perth, was one of the earliest sites of European settlement. Swan Valley swamps pool on the last piece of clay apron outwashed from the Darling Scarp. In the early part of last century they were full of Western Swamp Tortoises. There is one fossil record, dating from the

Miocene, found in North Queensland - but the Western Swamp Tortoise has been strictly Western Australian for many thousands of years. It would seem likely that they have been stranded on a geographical island of little more than 100-150 square kilometres - stretching between Pearce Airbase and Perth Airport - since long before the advent of Europeans (Kuchling 1995).

Within this area, they can only thrive in ephemeral, winter-wet, clay swamps adjacent to suitable aestivation sites. (The tortoises sleep underground for several months over summer.) Although they are dependent on a diet of aquatic organisms, permanent water bodies are not suitable habitat for Western Swamp Tortoises, because their shape and physiology mean they are not particularly good swimmers. Poor tortoises - caught between the foxes and the shallow, brown swamps. Suitable water bodies are evanescent because of the trend toward aridity in historic geological time. The drying of the swamps has been accelerated by below average rainfall in most years since the 1960s (whether this lack of rain is a purely local effect or a symptom of the enhanced greenhouse effect is hard to determine). To this dependence on a rare habitat, add a specialised biology that has a low fecundity and requires a wholly carnivorous diet. Altogether, the nearness of its approach to extinction should not surprise. There is cause for wonderment in the continued existence of any Western Swamp Tortoises at all. The odds against it winning a race for survival seem so overwhelmingly large.

But, then, so were the odds against Aesop's fabled tortoise. The one thing in favour of the Western Swamp Tortoise is the duration of its reproductive capacity. Not that it is a prolific breeder, by any yardstick. When it reaches maturity at between 10-20 years, the tortoise produces

an average of three to five eggs per clutch once a year and then only under optimum conditions. But in many years it won't reproduce at all. It is adapted to waiting out the floods and droughts of an unpredictable environment. Longevity is the strategy it has adopted to maximise its opportunities to reproduce. Turning that one advantage into a slim but real chance of survival has been an unlikely array of happenstance. To wit: the Austrian connection, a museum's mistake, and the generosity of the Western Australian community at a time well before one would expect a conservation issue to have evoked such a response (Kuchling, DeJose, Burbidge and Bradshaw 1992).

The Austrian Connection

The Vienna Museum holds the type specimen of *P. umbrina*. It was sent to them in 1839 by J.A. Ludwig Preiss, marked simply *Novae Hollandiae*. Preiss was in Western Australia from 1839 until 1841, so the Western Swamp Tortoise must have been one of his earlier acquisitions. It took another 60 years before it was described by a fellow Austrian, Siebenrock, in 1901. Siebenrock elaborated on his observations six years later. Then, once again, the Western Swamp Tortoise lapsed from scientific view for decades. The Austrian connection was established, but remained quiescent.

In 1953 two tortoises were found near Warbrook Road, 30 km north-east of the Perth G.P.O. and sent to the Western Australian Naturalists Club. Vincent Serventy, of the Naturalist's Club, observed them at the Club's annual Wildlife Show, and knew them to be unusual. He drew them to the attention of the (then) Director of the Western Australian Museum, Dr Ludwig Glauert. Glauert described them as a new species, *Emydura inspectata*, in 1954, but they were, in fact, revenants of the original *Pseudemydura umbrina*. (Ernest Williams of Harvard showed *inspectata* to be a synonym of *umbrina* in 1958.)

The appearance of a new species so very close to Perth was a good news story. When the 'new species' later proved to be the re-emergence of a supposedly extinct species, this did not detract from its newsworthiness. Remarkably, it generated a legacy of greater substance than a quickly-fading warm glow. A public subscription enabled the government of the day to establish two A Class Reserves in 1962, inviolable except by Act of Parliament, out of the only Western Swamp Tortoise habitat known to exist at that time. This collective responsiveness of media, government, public and private sponsors remains a crucial element of the Western Swamp Tortoise story. The combined weight of good will, backed by practical support, has been - twice at least - just sufficient to tip the balance in favour of the tortoises (Kuchling, DeJose, Burbidge and Bradshaw 1992). After the establishment of the Nature Reserves (65 ha at Ellen Brook and 155 ha at Twin Swamps, 5 km north-north-west of Ellen Brook) things seemed sweet for a while.

In 1959, the (then) Director of the Western Australian Museum, Dr David Ride, founded a captive population of 19 adults and six juveniles and began initial studies on the animals. This colony was transferred to the Perth Zoo in 1964. The previous year, Professor Bert Main of

the University of Western Australia took time out from his other studies, and set up a project on *P. umbrina* with several Zoology honours students, one of whom - Andrew Burbidge - would go on to do a comparative study of *P. umbrina*, *Chelodina oblonga* and *C. steindachneri*, two southern Western Australian long-necked tortoises. Dr Burbidge eventually became Director of the Threatened Species and Communities section of the Western Australian Department of Conservation and Land Management (CALM). He has maintained a connection with the subject of his doctoral studies, establishing some of the basic facts of the tortoise's biology and ecology. During the 1960s there were more than 200 tortoises at the Nature Reserves. By the late 1970s that had dropped to about 50. The captive population expanded slightly, producing 27 hatchlings between 1966 and 1977, but only four males and one female survived. By 1980, this fitful breeding had ceased altogether. By 1983, the population at Twin Swamps appeared to be extinct. And by 1987, there were less than 30 animals left in the wild. It would seem nothing short of a miracle could stop the free-fall to nothingness. Re-enter the Austrian connection.

If you want to find out about the Western Swamp Tortoise, you can have no better guide than Dr Gerald Kuchling of the University of Western Australia. Dr Gerald Kuchling was born in Vienna. He can't remember a time when turtles weren't a part of his life. When Kuchling was three years old his artist father brought home two Slider Turtles from Paris, and kept them in an aquarium. The father's interest became the son's passion. At five years of age it was terrestrial tortoises. By eight, Kuchling junior had secured his first aquarium, in which resided an American soft-shell turtle bought from a pet shop. Reptilia reigned. Hardly surprising, then, that as an adolescent he jumped at the chance of a part-time job working with the herpetological collection at the Museum of Natural History, Vienna. Kuchling's eye was drawn in particular to all the chelonian type specimens, which included two sent from Western Australia, the other side of the world: the Dinnerplate Tortoise, *Chelodina steindachneri* collected from the Gascoyne, and its miniature second cousin, the Western Swamp Tortoise, sent by Preiss. It may not have been apparent to him at the time, but this second encounter was a fateful one. Their destiny was conjunct.

In 1985, Professor Don Bradshaw of the University of Western Australia attended an ecophysiology conference in France. Kuchling was there talking about his work with Hermann's Tortoise, in Yugoslavia. Impressed, Bradshaw invited him to Western Australia to work on a project investigating the reproductive biology of *C. oblonga*. Kuchling accepted the offer. Already aware of the plight of *P. umbrina*, Kuchling made a point, once in Perth, of going to see the captive population at the Zoo. He also went to see the three potential breeders that had been transferred to the Wildlife Research Centre at Woodvale, under the aegis of Burbidge, for a more intensive scientific investigation. Injected with oxytocin (a drug which is used to induce labour in humans), these latter had produced three eggs in 1979 and 14 in 1980. Of the eight young that hatched, none survived for more than a few months. After that, no nests and no eggs. The captives had been

collected in 1959; they were over 50 years old. Perhaps 1980 had marked the end of their natural reproductive life? Who could tell? There was no question of invasive investigations, such as laparoscopy, when there were so few individuals left.

Last Chance Café

In July or August 1987, Gerald Kuchling wrote to Andrew Burbidge, suggesting that during September-October he offer the three female tortoises at Woodvale more food than they could eat. Burbidge followed that suggestion and during November two of the three females laid a total of seven eggs. Sadly, they did not develop, probably because the females were still not in good condition, yet it was the first glimpse of hope in eight years. Kuchling was asked to set up a breeding program.

So he proposed a full-scale reproductive rescue project for the captive *P. umbrina*. Of all the critical issues attendant on the tortoise's survival, this was paramount. In virtually all other cases of remnant populations, the critical problem is preserving or restoring sufficient suitable habitat. In the case of the Western Swamp Tortoise both reproduction and habitat issues had to be addressed simultaneously. Without renewed reproduction, the difficulties of marginal habitat, however pressing, would not need to be addressed at all. The Western Swamp Tortoise would not be going home. Funds were forthcoming from CALM, the World Wildlife Fund (WWF), the Australian National Parks and Wildlife Service (ANPWS) (renamed the Australian Nature Conservation Agency - ANCA - in 1992, Environment Australia in 1997 and the Department of Environment and Heritage (DEH) in 1999). Kuchling, employed by the Zoology Department of the University of Western Australia, began the captive breeding program in 1988, with a management committee consisting of himself, Bradshaw, Burbidge and John DeJose of the Perth Zoo.

Twelve animals were removed from the wild to be used in the program, at the same time as attempts were made to free their habitat of introduced predators (Burbidge and Kuchling 1994). Earlier attempts at fox baiting with strychnine in meat crackle had proved less than satisfactory. A compound called 1080 had proved remarkably effective elsewhere in Western Australia, so it was trialled. These baits contain a naturally-occurring compound of no threat to native wildlife. Unfortunately, 1080 proved less than ideal at Ellen Brook. Firstly, it is highly soluble in water and Ellen Brook Nature Reserve is under water for up to six months of the year. Secondly, these wet months are also the time of greatest tortoise activity, when they are most under threat of predation. Also, the Reserve is very small but the source of re-invading foxes is seemingly bounded only by the margins of the continent. Foxed, but undaunted, CALM, funded by ANPWS, surrounded the entire tortoise habitat in the reserve with a fox-proof fence. The work was begun in 1989 and completed in December 1990. The fence would keep out two known predators (foxes and dogs) and the suspects (cats), as well as keeping in the remaining Western Swamp Tortoises. They were now truly islanded.

Once again, though, gynaecological technologies developed for humans were applicable to the tortoises. The ultrasound techniques of assessing ovarian activity and egg production trialled in the *C. oblonga* study proved to be reliable (Kuchling and Bradshaw 1993). The very first ultrasound scan brought partially good news. Two of the females from the original captive population had active ovarian follicles, though no ovulation was taking place. Old as they were, the tortoises weren't menopausal, then! Between August 1987 and July 1991, a total of 16 adult and sub-adult females - the total known world population of female Western Swamp Tortoises - were regularly scanned using ultrasound techniques. The ultrasound is so precise that it is possible to distinguish freshly ovulated ova, even before the appearance of shell membranes. The rawest of ingredients for survival, eggs by themselves only offer a promise. Many other factors have to come together for this promise to reach fulfilment.

The simplified account of strategies for species' reproduction posits two extremes: breed in bulk and be damned, that is, accept a high mortality rate; or proceed with caution and reproduce only when conditions will optimise survival. For some species this means low numbers of offspring and long-term parental care. In the case of tortoises, though, parenting is a matter of quality time, not quantity. Once the mother has laid her eggs, she doesn't look back. In many years, however, the quality of conditions is not good enough for the Western Swamp Tortoise to risk laying eggs, so the female simply reabsorbs her pre-ovulatory follicles within her body (why waste good nutrients?), a process known as atresia. Counterbalancing this ovarian reticence is the capacity of tortoise sperm to survive for two to three years in the female's reproductive tract. Very handy - except it can create some confusion when trying to maintain the patrilineal genealogical records needed for the delicate genetic balancing of small captive breeding populations.

Hatchlings have a low survival rate in the wild. They need the best of conditions - good winter-spring rainfall, abundant food and low predator numbers - to have a chance of maintaining the population. It would seem that for these tortoises longevity is requisite, on the principle that if you hang around long enough, sooner or later you have to have a few lucky breaks. What about the captive population, then? Surely they were living in plenitude? Food supplied year round, well appointed ponds and enclosures? They had the potential to breed. What was troubling them?

A Modest Proposal

What was troubling them, troubled Kuchling also. So he read, he observed, he discussed. He pondered with tortoise-like persistence. And he came up with a recommendation: starve them. Starve them? The most endangered vertebrate in Australia. The most endangered chelonian species in the world. Fewer than 50 left. And this man wants to STARVE THEM? Well, it was more than a modest proposal, but one based firmly on the species' biology (Kuchling and DeJose 1989). In the wild the tortoises are well accustomed to a feast-and-

famine cycle, a pattern reflected in their scutes (the horn plates which overlay their bony shells). Much like growth rings on a tree, the scutes show an annular interruption to growth. The tortoises have six lean months over the aestivation period but, come September, if the rains have been good, they glut themselves on live aquatic animals: tadpoles, earthworms, *Daphnia* and small invertebrates of all kinds. If the females can't get a massive amount of nutrition in winter/spring they won't even lay eggs. It seemed to Kuchling that, given their habit of aestivation, they may also need to fast as part of a successful reproductive cycle.

It sounds plausible enough, but you can understand a certain reluctance to carry out the suggestion. Still, by 1988 it had been four years since any female had been seen in the wild. The captive tortoises were ageing and without offspring. The choice was between a slow attrition and a slight chance. Kuchling and his colleagues took the risk. In 1988, the captive tortoises were not fed for six months. Then, mimicking the best possible wild conditions, large amounts of high-quality food were supplied to them in September. The former Zoo diet of beef heart (there's a certain poetic justice in the beef heart, given the devastation cattle have wreaked on the tortoises' aestivation tunnels), with the occasional *soupçon* of calcium and mineral powders, and small marine fish like whitebait, was upgraded to a rich mix of blended prawns, squid, fish, beef heart, carrots, algae powder, protein and vitamin supplement and calcium carbonate in gelatine. It worked.

Kuchling had other recommendations - all based on the sound principle of echoing, as far as possible, critical features of the tortoises' natural habitat. Temperature, for instance. At night in the wild, swamp water is rarely warmer than 12°C from May or June until August. Even in the day it would be unlikely to exceed 18°C. The tortoises only get active when their body temperatures are above 15°C. Together with his partner Guundie Kuchling, Kuchling designed and built new ponds at the Zoo to simulate the same temperature gradients as those needed for tortoise thermoregulation in the wild. The new environments also provided a variety of resting and aestivation sites.

The starvation strategy and temperature regulation combined to kick start annual egg production. Incubated at a range of temperatures (in case the hatchling sex was temperature-determined, as it is for other reptiles such as crocodiles), these eggs yielded a total of 32 surviving captive-bred animals by 1992. A population increase of 75%! In 1991, the female tortoises from CALM's Wildlife Research Centre were returned to Ellen Brook Nature Reserve or the captive colony at the Zoo, and the Zoo took over management of the breeding program, continuing to use Kuchling as a principal adviser.

Breaking the breeding bottleneck was the first among equal priorities. Having achieved a solid start, it now became possible to give further attention to ameliorating a range of circumstances imperilling the tortoises. Guarding against the total vulnerability to disaster of a single population of an endangered species at one locality was

the next most immediate priority. On an island there is no escape from pests, epidemics or predators. The recovery team began to consider the possibility of re-introducing *P. umbrina* to the wild, in order to form a second population at Twin Swamps. Thought was also given to the development of an ambitious and comprehensive recovery plan. The Western Swamp Tortoise turned out to have a further advantage, according to Burbidge, in that its ecological needs are comparatively simple and well understood. On this basis, it was decided to attempt an apprenticeship in creation management by, first of all, modifying the marginal habitat at Twin Swamps so it more closely matched the tortoises' requirements. This involved artificially extending the swamp's life by using a bore donated by the Water Authority, and monitored by CALM staff.

As well as adjusting the existing reserved habitats, the team wanted to reconstruct tortoise habitat in areas within the species' former range. To do so required buying back land and that, in turn, required money. Generous private and corporate sponsorship, often stimulated by media coverage, has been invaluable in this respect. The process is ongoing. Good will has been, and remains, critical to the whole attempt: maintaining cordial relations with property owners whose land borders the reserves (a sensitive business, at times); negotiating with the brick companies who have vested interests in the region; drawing on a pool of voluntary labour from the conservation minded; continuing to use the media to best advantage. In some senses it could be considered an exercise in public relations.

The most successful part of this campaign, by far, was the publication of a children's book *Yakkinn The Swamp Tortoise - The Most Dangerous Year*, a team effort by Gerald and his wife Guundie, who is a professional artist. This award-winning book and its sequel *Yakkinn The Swamp Tortoise - Survival* were part of a deliberate, long-term strategy to educate the public about the Western Swamp Tortoise. The book is now in school libraries throughout Australia.

The strategic work had to be underpinned with hard physical labour. Trapping, tagging and monitoring tortoises means slogging through swamps, and constructing drift net fences can be back-breaking. Again, much of this was achieved with teamwork from the Kuchlings. Gerald and Guundie continue to fight on every front available to educate, negotiate and labour in the swamps, building tunnels and restoring habitat. They now have a small cadre of volunteers to help - *The Friends of the Western Swamp Tortoise*. Altogether, there are very tangible benefits to intangible good will.

In the early days of the project, there were still very few hatchlings at Ellen Brook, and any nest was monitored very carefully. If it was at risk, fifty per cent of the eggs were taken to be incubated at the zoo. The wildlings that survived were tagged and released back at Ellen Brook. These days the breeding program is counted as an international success story, and there are ongoing releases of *Pumbrina* into suitable habitat. Ethical management of captive breeding populations is never simply a numbers

game, though. It demands extremely tight management of the very small genetic inheritance represented in even the expanded tortoise population (Kuchling 1995). Without this, captive breeding can easily dissolve into a Faustian bargain. The less-than-scrupulous are prepared to exchange the robust genetic diversity (which optimises an animal population's evolutionary future) for a large number of genetically impoverished individuals.

Captive Breeding – A Faustian Bargain?

It's a deal Kuchling refuses to strike. He takes as his central premise the concept of a viable population: survival of a population *in a state that maintains its vigour and its potential for evolutionary adaptation*, as defined by Soulé, a doyen of conservation biology. But creation management is not creation as such, so the recovery team would have to take the given genetic material and wring every last bit of potential variation out of it. Longevity once again weighed in the tortoise's favour: because the captive population consisted mostly of animals taken from the wild at a time when the population was less depleted, its genetic resources would be richer than those of a species with a shorter generation time, further removed from their wild state. Finding out the exact nature of the tortoise's genetic resources required genetic fingerprinting. Minisatellite and microsatellite probes may sound like invasive nanotechnology, but they require little more than a drop of blood. Better still, the embryonic membrane which has been collected from every hatchling born since 1991 has proved to have hatchling-specific DNA. Postmodern magic!

The initial minisatellite probes of *P. umbrina* revealed a monotonous degree of sameness. The original two populations (one at Ellen Brook, one at Twin Swamps) are genetically identical, and there is not a great deal of variability between individuals. Is this simply the nature of the particular beast? Or is it the nature of all beasts of that ilk, that is, chelonians with a similar ecology and population structure? Or is it an artefact of a series of breeding bottlenecks pre-dating its most recent decline? Distinguishing among these hypotheses will be crucial for the management of the species' future chances.

The breeding strategy of the Western Swamp Tortoise - random mate selection and forceful insemination attempts - is not ideologically palatable to most humans, nor is it typical. Apart from *P. umbrina*, Australian chelonians are uniformly aquatic swimmers, with females larger than males, and definitely in charge of the choice of mate. But for the agendas of genetic management, the Western Swamp Tortoise's 'male chauvinism' is useful because random mixing of the entire gene pool falls within the animal's natural behaviour patterns. (Imagine, for example, the difficulties of maximising genetic variability if you had fewer than 50 individuals of a bird species that mated for life.) In their natural habitat, males and females are not constantly together. They have large home ranges, but it is known that in winter (the breeding season)

the females move less, spending their time basking and fattening up, whereas the males move further and bask less. Keeping both sexes together constantly may have been yet another reason the captive population originally faltered and failed in their breeding. Now there is strict segregation, which enables the females to have enough peace to put on the necessary amount of weight. This nutrient stock not only has to carry them through the high-energy activities of ovulation (sometime between the end of September and the end of October) and nesting (35-49 days later), but also through the following six or seven months of fasting while in aestivation. They need all the food and rest they can get.

Segregation is also one aspect of establishing tortoise patrilineages. This is still problematic, however, because of the sperm's capacity to remain viable in the oviduct for two years or more. Even when the recovery team began introducing one male exclusively to one female in the breeding season (as opposed to the *laissez-faire* approach taken up until then) it was not possible to be certain of paternity. The uniformity of *Pumbrina*'s genetic material meant that minisatellites were unenlightening on this point. But microsatellites show much finer distinctions, actually allowing alleles to be assigned to a particular location on the gene sequence. *Voila!* Now it was possible to pinpoint paternity. This conferred the degree of precision needed to ensure the population retained its capacity for an evolutionary future.

Exhilarating as the success of the captive breeding program must have been, it did not, for Kuchling, obscure the fact that it may just leave the Western Swamp Tortoise all dressed up with no place to go. Even the most scrupulously managed captive breeding program must be counted a failure if it cannot ultimately deliver animals back to the habitat whence they came. An ark is a fine thing, indeed, but it is not the Earth. The early securing of the Ellen Brook and Twin Swamps Nature Reserves was an essential step in ensuring the tortoise's survival, but subsequent knowledge has shown these reserves to be marginal habitat, and thus even more susceptible to climatic vagaries.

The degree to which the smallness and vulnerability of the tortoise is matched by the smallness and vulnerability of its islanded habitat was brought home to me forcibly on the first day of spring, 1994. I had arrived at the Zoology Department of the University of Western Australia to meet Kuchling for the first time, and travel with him to the Swan Valley. In another context it might have been a pleasant drive through a pastoral idyll for the purposes of wine tasting. The Swan Valley was one of the few regions of Western Australia with the fertile soils suited to European agriculture. It was settled early and extensively, and its history features prominently in colonial culture. Look again at the interstices among the Arcadian grape groves and you may glimpse other realities. The Swan Valley Nyoongahs, for example, who know the Western Swamp Tortoise as *Yakkinn*. Or the road train assembly area where the truckers gather, gearing up for the long haul across the country to the east coast. Or the clay so pure it needs no refinement

but can be put immediately to the making of bricks and tile. Industry and agriculture. Indigene and invader. So many competing claims. And in the midst of it all, the tortoise with its precarious toehold on the planet. It's as slippery as the swamp through which I track Kuchling, who tracks tortoises, attempting awkwardly to move when he moves and freeze when he pauses.

Kuchling is looking for a single, wild female he had found at Twin Swamps a few weeks previously. This had been the first sighting of a wild tortoise at Twin Swamps for eleven years. He bears aloft the standard of a radio tracking antenna, which picks up transmissions from a tiny receiver glued to the back left-hand side of the animal's carapace. Apart from this, we walk in silence. But it is far from a silent world. Overhead roar jets from Pearce airbase. Traffic noise from the nearby Great Northern Highway is low but constant. At Ellen Brook, domestic and animal sounds from neighbouring properties cut clear across the 65 ha reserve. Late in the afternoon I am following immediately in Kuchling's footsteps when a phone rings. The sound carried so clearly it seemed to be coming from his back pack, but it was from a neighbouring property. The tortoises have acute hearing. I couldn't help but wonder if they weren't longing for some kind of life beyond Thunderdome. Or are they inured? Or does it not factor at all in a testudinate stress curve?

The Witness of Tortoises

How do the tortoises perceive their world? It's impossible for us to tell, but impossible also to resist the temptation to imagine. It may even be in some subtle, not necessarily rational, way *necessary* for both our survivals that we do so imagine. Thus Kuchling, speaking now not as the scientist, but as the witness of tortoises, speculates that they may have gestalts, mind maps of their territory constructed of who-knows-what sensory input. He has observed an animal emerge from aestivation at the initial rain of the season and move unerringly - over more than 500 metres - through dense bush land straight to the first-formed puddle. Picking up a stick, Kuchling traces the path of another tortoise whose passage through winter described a large semi-circle, coming close to the fenceline for a while, but eventually arcing back to the reserve's centre by spring time. After digging a nest with her front legs (a habit unique to the Western Swamp Tortoise) she settled down to produce her clutch. When finished she moved a little further around the circumference and sat down to rest for a while. Then, when the time seemed right she moved in a direct line across the diameter of the circle straight back to her aestivation site. More disturbingly, two females repeatedly tried to leave Twin Swamps Reserve and move to clay pans Kuchling knows of that are further west. Tortoises are long-lived animals. What fusion of memory and desire fuels such epic journeys? What cost the fox-proof fence artificially islanding such ancient territories?

'Creation management' is shot through with such poignancies. At a recently-acquired block, south of Ellen Brook, Kuchling is reserved but enthusiastic as he shows me aestivation tunnels he has constructed. The

concrete entrances are carefully concealed, the burrows are covered with brushes and twigs, overlain with linen sacks that, in turn, are overlain with clay. They are a fair imitation of the fretwork tunnels formed naturally when water drains from the Gilgai clay. This is land that is being reclaimed for tortoise habitat, after the ravages of hoofed animals collapsed their kingdom. In another mood I would have been enchanted with the ingenuity. Late on this day, though, I turn away quickly lest my face betray me once again. It seems unbearably sad. Like we are a race of retarded giants, for the most part good willed giants, attempting to mend the Ming vase we have inadvertently smashed. But what choices do we have?

Those of us who, in some senses, care for non-human animals often see our choices as polarised into two - seemingly irreconcilable - positions. One group has a passionate connection to animals as individuals, and an ethical position on the rights of individual animals, but is frequently blind to whole scale destruction of species. The other group has an equally passionate commitment to animals as species groups or members of ecosystems, and an ethical position on diversity that often elides the suffering of individual animals. Just as in solely human affairs, extremes of 'individualism' or 'collectivism' are insufficient. The creation of a robust ethics of human-animal interactions requires both. Barbara Noske (2004) is one of the few writers to present a case for drawing out the best from each approach. She opens up rich possibilities for conversations across this divide, whilst acknowledging that there will be no simple answers.

It is necessary, but by no means easy, to theorise about the ethics of life and death situations. Debates about euthanasia, for instance, should take place in the academies, the clinics, the churches, the synagogues, the temples, the mosques. Knowledge of these debates must in some measure provide the framework that governs human behaviour *in extremis*. But neither should we fail to note there is a difference between the claims of abstract morality and the call made on our humanity when faced with the sensuous immediacy of an agonising death, our own or others. There can be no set answers for such irreducibly complex ethical decisions. Just as there can be no absolute purity in any ethical position we take in our relationship with animals. The impossibility of attaining perfect *ahimsa*, or non-harming, is well acknowledged by the Jains, a Buddhist sect that endeavours to move as close as humanly possible to such an end. Acknowledging that impossibility does not, of course, absolve us of the responsibility of grappling with the destructive consequences of any position we do take viz a viz other animals - and attempting to reduce negative consequences as much as possible.

It is well, therefore, to reflect on the fact that human attempts to manipulate environments, even when in favour of other species, are interventionist, often technicist, and susceptible to the flaws that accompany all human endeavour. Kuchling, like the best of all such interventionists, constantly reflects on the dangers inherent in his enterprise. Yet many Australian species of animal are in a life-and-death struggle, either initiated

or greatly exacerbated by human behaviour. As a species, humans are an extinction-level-event. I do not think we can choose - out of a false sense of ideological purity - to leave these situations to non-human nature alone. We are involved whether we like it or not.

Neither does the recognition of the anthropocentric and plastic nature of categories such as 'extinction' or even 'species' conveniently free us from a degree of duty of care for our co-inhabitants of the planet. Extinction - like death - is a vastly complex and compelling cultural construct, but it also points to an irrevocable material reality. I don't believe in absolute scales, but genocide - the extinction of a whole group of human beings - would seem to me a greater evil than the murder of individuals or the massacre of groups. This in no way implies that the other evils should be ignored or accepted. The lived reality of genocide takes place individual by individual; and it may well be that tolerance of cruelty or destruction on a case-by-case basis is at the root of cultural contexts in which genocide is allowed to flourish. The chaotic nightmare of genocide in action is a person-by-person encounter with the hot breath of evil.

For me, though, I cannot help but feel that the loss of an entire culture, ethnicity, language and culture group - compounded as it is of the loss of each individual within the group - leaves the world immeasurably poorer because of the total absence of the group. When a unique way of being in the world is gone without hope of return; when this occurs because of indifference or active persecution, I shiver at even the remotest contemplation of such an unimaginably cold evil.

I feel the same way about the relative evils of anthropogenic species' extinction and the death of individual or groups of animals. And I don't believe that to work against the former automatically means that you must be callous or indifferent to the latter, although it sometimes is that way. Conversely, working for the rights of individual animals is not necessarily incompatible with working for

species' preservation. The history of misunderstanding and conflict between these polarised positions does not further the debate. As much as possible I seek to move from an 'either/or' to a 'yes and' position.

On the big scale, of course, individual death and species' extinction are inevitable. There is no sense in inflating either our power-over or our guilt-about fantasies beyond the human scale. It is only insofar as humans are actively implicated in such matters that we can and should seek to minimise harm and maximise life. This will always be a small-scale and imperfect business. Ethically managed captive breeding buys us time in which we might find better ways to reintegrate ourselves with the other animals - as many and diverse species as is possible. This story has been about one man's attempts to do just that. Kuchling is a truly gifted scientist, yet being with him, watching him work, is not seeing some remote and objective automata of reason. Imperfect, subjective, rational and intuitive, his practice of science is rigorous, but it is not dangerously disconnected from nature. It draws strongly on high technology. Yet to see Kuchling at work in the Swan Valley swamps is to witness something more rarely acknowledged than the subjectivity of science; to catch a glimpse of something more rarely seen than a Western Swamp Tortoise: it is to understand that science can be an expression of love.

Six days after first following Kuchling through these swamps, I came back to Twin Swamps. I joined the gaggle of people gathered outside the fence. Then - together with politicians, scientists, journalists - I trekked into the swamp to witness the release of the first captive-bred tortoises. Okay, so it was an unparalleled photo opportunity, but cynicism itself was suspect on this occasion. From the beginning politicians, scientists and journalists have sometimes had a positive role to play in this story. I know that this victory, like all victories, has come at a cost. I know that we are clumsy and monumentally ignorant but I believe that moments of redemption are still possible.

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APPENDIX I



Figure 1. Dr Gerald Kuchling using radio tracking to monitor tagged and released Western Swamp Tortoises. Photo: J. Lochman/Lochman Transparencies



Figure 2. Western Swamp Tortoise Photo: J. Lochman/Lochman Transparencies



Figure 3. Although the captive breeding program is very successful, threats to suitable habitat remain a major issue for the Western Swamp Tortoise.
Photo: G. Kuchling



Figure 4. Ellen Brook Nature Reserve seen from the air reveals the smallness and vulnerability of the tortoises' habitat.
Photo: G. Kuchling

APPENDIX I



Figures 5 and 6. Illustrations from the Yakkinn the Swamp Tortoise picture books. These award-winning books by Guundie and Gerald Kuchling brought the Western Swamp Tortoise story to children throughout Australia.

Photo: G. Kuchling



Figure 7. Captive bred hatchling about to be released.

Photo: L. J. Christensen